OCCUPATIONAL ANALYSES SERIES

Machinist

2005

Human Resources and Skills Development Canada
Ressources humaines et Développement des compétences Canada

Canada

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Occupational Analyses Series

Machinist

2005

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Human Resources
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Machiniste

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The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this Occupational Analysis as the national standard for the occupation of Machinist.

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OTHER RELATED OCCUPATIONAL TITLE

This analysis covers tasks performed by machinists whose occupational title has also been identified by some provinces and territories of Canada by the name of General Machinist.

LIST OF RED SEAL NATIONAL OCCUPATIONAL ANALYSES

TITLE	NOC* Code
Appliance Service Technician (1997)	7332
Automotive Painter (2005)	7322
Automotive Service Technician (2005)	7321
Baker (1997)	6252
Boilermaker (2003)	7262
Bricklayer (2000)	7281
Cabinetmaker (2000)	7272
Carpenter (1998)	7271
Cement Finisher (1995)	7282
Construction Electrician (2003)	7241
Cook (2003)	6242
Electrical Rewind Mechanic (1999)	7333
Electronics Technician – Consumer Products (1997)	2242
Farm Equipment Mechanic (2000)	7312
Floorcovering Installer (2005)	7295
Glazier (2004)	7292
Hairstylist (2005)	6271
Heavy Duty Equipment Technician (2004)	7312
Industrial Electrician (2003)	7242
Industrial Instrument Mechanic (2000)	2243
Industrial Mechanic (Millwright) (1999)	7311
Insulator (Heat and Frost) (2000)	7293
Ironworker (Generalist) (1993)	7264
Lather (Interior Systems Mechanic) (2002)	7284
Machinist (2005)	7231
Metal Fabricator (Fitter) (2003)	7263

Mobile Crane Operator (1997)	7371
Motorcycle Mechanic (1995)	7334
Motor Vehicle Body Repairer (Metal and Paint) (2005)	7322
Oil Burner Mechanic (1997)	7331
Painter and Decorator (2000)	7294
Partsperson (2005)	1472
Plumber (2003)	7251
Powerline Technician (2004)	7244
Recreation Vehicle Mechanic (2000)	7383
Refrigeration and Air Conditioning Mechanic (2004)	7313
Roofer (1997)	7291
Sheet Metal Worker (1997)	7261
Sprinkler System Installer (2003)	7252
Steamfitter – Pipefitter (1996)	7252
Tilesetter (2004)	7283
Tool and Die Maker (1997)	7232
Transport Trailer Technician (2003)	7321
Truck and Transport Mechanic (2000)	7321
Welder (2004)	7265

* National Occupational Classification

Requests for these publications should be forwarded to:

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These publications are also available to order or download online at: **www.red-seal.ca**.

FOREWORD

The first National Conference on Apprenticeship in Trades and Industries, held in Ottawa in 1952, recommended that the federal government be requested to co-operate with provincial apprenticeship committees and officials in preparing analyses of a number of skilled occupations. To this end, Human Resources and Skills Development Canada (HRSDC) sponsors a program, under the guidance of the Canadian Council of Directors of Apprenticeship (CCDA), to develop a series of occupational analyses.

The Occupational Analysis Program has the following objectives:

- to identify and group the tasks performed by skilled workers in particular occupations;
- to identify those tasks that are performed by skilled workers in every province and territory;
- to develop instruments for use in the preparation of Interprovincial Standards "Red Seal" Examinations and curricula for training leading to the certification of skilled workers;
- to facilitate the mobility, in Canada, of apprentices and skilled workers;
- to supply employers and employees, and their associations, industries, training institutions and governments with analyses of the tasks performed in particular occupations.

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GUIDE TO ANALYSIS

DEVELOPMENT OF ANALYSIS

A draft analysis is developed by a committee of industry experts in the field led by a team of facilitators. This draft analysis identifies all the tasks performed in the occupation.

The draft is translated and reviewed by the NOA Team of HRSDC. A copy of this analysis is then forwarded to provincial/territorial authorities for review by specialists in the field. Their recommendations are assessed and incorporated into the final draft.

The occupational analysis is published in both official languages.

STRUCTURE OF ANALYSIS

To facilitate understanding of the nature of the occupation, the work performed is divided into the following divisions:

BLOCK – is the largest division within the analysis and reflects a distinct operation relevant to the occupation.

TASK – is the distinct activity that, combined with others, makes up the logical and necessary steps the worker is required to perform to complete a specific assignment within a "BLOCK".

SUB-TASK – is the smallest division into which it is practical to subdivide any work activity and, combined with others, fully describes all duties constituting a "TASK".

Supporting Knowledge & Abilities

The elements of skill and knowledge that an individual must acquire to adequately perform the sub-task.

Trends

Any shifts or changes in technology that affect the block.

Related Components

All components related to a specified block being undertaken by the machinist.

Tools and Equipment

All tools and equipment necessary for the machinist to perform the work on all given tasks identified within the block.

VALIDATION METHOD

At the request of the Canadian Council of Directors of Apprenticeship (CCDA), the Standardization Sub-committee developed a method for validating the Red Seal National Occupational Analyses.

A draft of the analysis is sent to all jurisdictions for validation. Each jurisdiction rates the sub-tasks and applies percentage ratings to blocks and tasks. This method for the validation of the National Occupational Analysis identifies common core tasks across Canada for a specific occupation. This feature facilitates the weighting of the Interprovincial Standards "Red Seal" Examinations.

DEFINITIONS

YES: the sub-task is performed by workers in the occupation in a specific jurisdiction.

NO: the sub-task is not performed by workers in the occupation in a specific jurisdiction.

BLOCK %: the average number of questions (items), derived from the collective decision made by workers within the occupation from all areas of Canada, that will be placed on an interprovincial examination to assess each block of the analysis.

TASK %: the average number of questions (items), derived from the collective decision made by workers within the occupation from all areas of Canada, that will be placed on an interprovincial examination to assess each task of the analysis.

NV: Not Validated by a province/territory.

ND: Not Designated in a province/territory.

PROVINCIAL/TERRITORIAL ABBREVIATIONS

NL: Newfoundland and Labrador
NS: Nova Scotia
PE: Prince Edward Island
NB: New Brunswick
QC: Quebec
ON: Ontario
MB: Manitoba
SK: Saskatchewan
AB: Alberta
BC: British Columbia
NT: Northwest Territories
YT: Yukon
NU: Nunavut

COMMON CORE

The criteria for determining common core depend on the performance of sub-tasks. If at least 70% of the responding jurisdictions (excluding NVs and NDs) perform a sub-task, it shall be considered common core.

Interprovincial Standards "Red Seal" Examinations are based on the common core identified through this validation process. Validation identifies what will be assessed through the interprovincial examination.

BLOCKS AND TASKS WEIGHTING (APPENDIX D)

This appendix represents the block and task percentages as submitted by each jurisdiction.

Each jurisdiction, with the use of a provincial/territorial occupational advisory committee, validates the content, places percentages on blocks and tasks, and indicates whether or not the sub-tasks are performed by the skilled workers within the occupation. The results of this exercise are submitted to the NOA Team who then analyzes the data and develops this appendix which provides the individual jurisdictional validation results as well as the national averages of all responses.

PIE CHART (APPENDIX E)

The graph depicts the national percentages assigned to blocks in the analysis.

SCOPE OF THE MACHINIST OCCUPATION

Machinists possess the knowledge and abilities to set up and operate machines that cut or grind metal and other materials into products with precise dimensions. These machines include lathes, milling machines, saws, grinding machines, drilling machines and boring machines.

Machinists work from drawings, specifications and their own measurements to calculate dimensions, tolerances and types of fit. They must be knowledgeable about the properties of metal, plastic, rubber and composite materials.

Precise measurements are critical to machinists' work. Machinists operate conventional and Computer Numerical Control (CNC) machine tools.

Machinists may work in industries where machines are manufactured, repaired or used. These may include industries that manufacture machinery equipment, motor vehicle parts or aerospace parts. The machinist machines precision parts that are used in all aspects of manufacturing. They also work in shipyards, railyards, refineries, pulp and paper mills, mines, smelters and metal fabricating and overhaul shops. Shiftwork is common in some companies. Machinists tend to work indoors.

Safety is important at all times. There are risks of injury working with moving machine parts, sharp edges and extreme heat from heated materials. Precautions are required while working with manufacturing chemicals and airborne irritants.

Key attributes for people entering this trade are: communication skills, mechanical aptitude, hand-eye coordination, manual dexterity, an ability to work independently, and an understanding of mathematics and physics. Physical condition is important because the work often requires considerable standing and handling heavy objects. This analysis recognizes similarities or overlaps with the work of other tradespeople such as tool and die makers, mould makers, welders and industrial mechanics (millwrights).

Experienced machinists may move into supervisory positions. With additional training they may transfer their skills to related occupations such as tool and die maker, mould maker, industrial mechanic (millwright) or CNC programmer.

OCCUPATIONAL OBSERVATIONS

Computer numerical control (CNC) machining has transformed and continues to transform the work of machinists. It is now used in even low production runs where manual machines had previously been used. CNC machines are programmed by machinists or dedicated programmers, but as CNC machines become more versatile, the number of manual machines declines. There is also an increased use of hybrid machines (manual/CNC).

There will still be a need for highly trained machinists who have the knowledge and expertise of conventional machining.

SAFETY

Safe working procedures and conditions, accident prevention and the preservation of health are of primary importance to industry in Canada. These responsibilities are shared and require the joint efforts of government, employers and employees. It is imperative that all parties become aware of circumstances that may lead to injury or harm. Safe learning experiences and work environments can be created by controlling the variables and behaviours that may contribute to accidents or injury.

It is generally recognized that safety-conscious attitudes and work practices contribute to a healthy, safe and accident-free work environment.

It is imperative to apply and be familiar with the Occupational Health and Safety Acts and Workplace Hazardous Material Information System (WHMIS) Regulations. As well, it is essential to determine workplace hazards and take measures to protect oneself, co-workers, the public and the environment.

As safety education is an integral part of training in all jurisdictions, personal safety practices are not recorded in this document. However, the technical safety aspect relating to each task and sub-task are included throughout this analysis.

ANALYSIS

BLOCK A

OCCUPATIONAL SKILLS

Trends: *Increased use of coordinate measuring machines (CMM). Increased documentation and traceability of parts through standards systems such as ISO 9100 and QS 9000. Increased use of non-destructive testing (NDT). Stricter environmental controls on material disposal. Increased recycling of coolant and waste materials. Increased use of electronic communication devices for job instruction, technical reference, machine monitoring and workpiece specifications.*

Related Components: Not applicable.

Tools and Equipment: See Appendix A.

Task 1 Uses tools and equipment.

Sub-task

1.01 Uses hand tools.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

Supporting Knowledge & Abilities

1.01.01	knowledge of types of hand tools
1.01.02	knowledge of imperial and metric systems
1.01.03	ability to apply hand-eye coordination
1.01.04	ability to organize hand tools
1.01.05	ability to maintain hand tools
1.01.06	ability to store hand tools
1.01.07	ability to recognize worn, damaged or defective hand tools

Sub-task

1.02 Uses power tools.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

1.02.01	knowledge of types of power tools such as electric, pneumatic and hydraulic
1.02.02	knowledge of operating procedures
1.02.03	ability to apply hand-eye coordination
1.02.04	ability to organize power tools
1.02.05	ability to maintain power tools
1.02.06	ability to store power tools
1.02.07	ability to recognize worn, damaged or defective power tools

Sub-task

1.03 Uses measuring tools.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

1.03.01	knowledge of types of measuring devices such as micrometers, vernier calipers, gear tooth verniers, protractors, sine bars and gauge blocks
1.03.02	knowledge of imperial and metric systems
1.03.03	ability to organize measuring devices
1.03.04	ability to maintain measuring devices
1.03.05	ability to store measuring devices
1.03.06	ability to recognize worn, damaged or defective measuring tools

Sub-task

1.04 Uses hoisting, lifting and rigging equipment.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

1.04.01	knowledge of types of hoisting and lifting equipment such as jacks, chain hoists and overhead cranes
1.04.02	knowledge of applications of hoisting, lifting and rigging procedures
1.04.03	knowledge of limitations of lifting equipment
1.04.04	knowledge of hoisting and lifting equipment maintenance
1.04.05	knowledge of hand signals
1.04.06	ability to recognize worn, damaged or defective hoisting and lifting equipment

Sub-task

1.05 Uses layout tools and equipment.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

1.05.01	knowledge of types of layout tools and equipment such as height gauges, angle plates, scribers and surface tables
1.05.02	knowledge of imperial and metric systems
1.05.03	ability to organize layout tools and equipment
1.05.04	ability to maintain layout tools and equipment
1.05.05	ability to store layout tools and equipment
1.05.06	ability to recognize worn, damaged or defective layout tools and equipment

Sub-task

1.06 Uses personal protective equipment (PPE) and safety equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

Supporting Knowledge & Abilities

1.06.01	knowledge of types of PPE such as respiratory, hearing, eye and body protection
1.06.02	knowledge of PPE and safety equipment operations
1.06.03	knowledge of workplace safety and health regulations
1.06.04	knowledge of location of PPE and safety equipment
1.06.05	ability to inspect and maintain PPE and safety equipment
1.06.06	ability to store PPE and safety equipment
1.06.07	ability to recognize worksite hazards
1.06.08	ability to recognize worn, damaged or defective PPE and safety equipment

Sub-task

1.07 Uses basic welding equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	no	yes	yes	yes	no	NV	NV	NV

Supporting Knowledge & Abilities

1.07.01	knowledge of types of welding equipment such as oxyacetylene and metal inert gas (MIG)
1.07.02	knowledge of basic welding operating procedures

1.07.03	ability to perform basic welding and heating applications such as bending, heat treating, and tacking
1.07.04	ability to apply hand-eye coordination
1.07.05	ability to organize welding equipment
1.07.06	ability to maintain welding equipment
1.07.07	ability to store welding equipment
1.07.08	ability to recognize worn, damaged or defective welding equipment

Task 2 Organizes work.

Sub-task

2.01 Interprets documentation.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

2.01.01	knowledge of first and third angle projection
2.01.02	knowledge of symbols such as surface finishes, scales and tolerances
2.01.03	knowledge of types of documentation such as work orders, technical data and reference manuals
2.01.04	ability to use reference material such as *Machinery's Handbook*, tool specifications and material specifications
2.01.05	ability to read and interpret drawings such as blueprints, engineering drawings and sketches

Sub-task

2.02 Plans sequence of operation.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

2.02.01	knowledge of machining operations such as turning, milling and grinding
2.02.02	knowledge of material characteristics such as composition, properties, application and machinability
2.02.03	knowledge of time required to complete each operation
2.02.04	knowledge of heat treatment required
2.02.05	ability to plan work procedures
2.02.06	ability to prioritize operations

Sub-task

2.03 Maintains safe work environment.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

2.03.01	knowledge of Workplace Hazardous Materials Information System (WHMIS)
2.03.02	knowledge of federal and provincial/territorial safety regulations such as the *Occupational Health and Safety Act* (OHSA)
2.03.03	knowledge of types and operation of fire extinguishing equipment
2.03.04	knowledge of disposal and recycling procedures

2.03.05	knowledge of work hazards such as those associated with the operation of hand and power tools, cutting, grinding and machining equipment
2.03.06	knowledge of workplace housekeeping procedures and practices
2.03.07	knowledge of absorbent materials
2.03.08	knowledge of lockout procedures
2.03.09	ability to recognize potential hazards specific to each machining and work location
2.03.10	ability to handle and store hazardous materials
2.03.11	ability to organize and maintain a clean and safe work area

Sub-task

2.04 Communicates with others. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

2.04.01	knowledge of technical terminology
2.04.02	knowledge of verbal and written communication
2.04.03	ability to use communication equipment and media such as Internet, email and fax
2.04.04	ability to translate technical information into layperson's terms
2.04.05	ability to gather information from customers about workpiece
2.04.06	ability to communicate with other related professionals such as engineers, supervisors and co-workers
2.04.07	ability to communicate with customers

Task 3 Processes material.

Sub-task

3.01 Selects workpiece material.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

3.01.01	knowledge of types and grades of material
3.01.02	knowledge of material characteristics such as composition, properties, application and machinability
3.01.03	knowledge of identification markings such as ASME systems, ANSI systems, colour codes and number systems
3.01.04	knowledge of material measurements
3.01.05	ability to determine material type and shape required
3.01.06	ability to visually inspect material for faults such as bends, cracks and size deviations

Sub-task

3.02 Performs layout.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

3.02.01	knowledge of layout procedures
3.02.02	knowledge of layout media such as dyes, paint, markers and coating
3.02.03	ability to apply geometry and trigonometry principles
3.02.04	ability to use charts and scientific calculators

Sub-task

3.03 Marks workpiece for identification.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

3.03.01	knowledge of marking procedures such as etching, engraving, colour coding and stamping
3.03.02	ability to mark workpiece without compromising the integrity of the workpiece

Sub-task

3.04 Performs basic heat treatment.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

3.04.01	knowledge of metallurgy
3.04.02	knowledge of types of heat treatment processes such as hardening, normalizing, annealing and stress relieving
3.04.03	knowledge of tempering colours
3.04.04	ability to perform basic procedures such as flame hardening and quenching
3.04.05	ability to apply hardness tests such as scratch, Brinell and Rockwell

Sub-task

3.05 Applies material testing.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

3.05.01	knowledge of metallurgy
3.05.02	knowledge of types of defects and faults
3.05.03	ability to visually inspect material
3.05.04	ability to perform basic non-destructive testing (NDT) such as dye penetrant

Sub-task

3.06 Deburrs workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

3.06.01	knowledge of deburring techniques
3.06.02	ability to use deburring tools such as files, chisels, rotary deburrers, scrapers and abrasive stones
3.06.03	ability to assess and identify burrs and rough edges
3.06.04	ability to remove burrs to meet specifications
3.06.05	ability to secure workpiece

Sub-task

3.07 Inspects workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

3.07.01	knowledge of inspection procedures and techniques such as incoming, in-process and final
3.07.02	knowledge of required dimensions and dimensional accuracy
3.07.03	knowledge of geometric dimensioning and tolerancing
3.07.04	ability to perform inspection techniques such as visual and manual verification using inspection equipment
3.07.05	ability to measure gears

Sub-task

3.08 Sketches parts.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

3.08.01	knowledge of sketching techniques
3.08.02	knowledge of third angle projection
3.08.03	knowledge of dimensioning practices
3.08.04	ability to sketch in third angle projection

Task 4 **Maintains machines and tooling.**

Sub-task

4.01 **Cleans machines.**

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

4.01.01	knowledge of manufacturers' specifications
4.01.02	knowledge of cleaning techniques and requirements
4.01.03	knowledge of cleaning solvents
4.01.04	knowledge of cleaning equipment
4.01.05	knowledge of machine lockout procedures
4.01.06	knowledge of sensitive components
4.01.07	ability to clean chips from inactive machine

Sub-task

4.02 **Lubricates machines.**

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

4.02.01	knowledge of manufacturers' specifications
4.02.02	knowledge of types of lubricants
4.02.03	knowledge of lubrication points
4.02.04	knowledge of maintenance schedule
4.02.05	ability to use lubrication equipment such as grease gun, oil gun and oil feeders
4.02.06	ability to check oil levels
4.02.07	ability to perform preventative maintenance

Sub-task

4.03 Sharpens tooling.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

4.03.01	knowledge of tool geometry such as rake angles, relief angles and chip breakers
4.03.02	knowledge of types of tool sharpening equipment such as tool and cutter, pedestal and drill grinders
4.03.03	ability to set up grinding equipment
4.03.04	ability to perform sharpening operations

Sub-task

4.04 Applies cutting fluid and coolant.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

4.04.01	knowledge of types of cutting fluids such as oil and water soluble fluids
4.04.02	knowledge of types of coolants and application techniques
4.04.03	knowledge of mixing procedures
4.04.04	ability to maintain concentration of soluble fluids
4.04.05	ability to follow a maintenance schedule
4.04.06	ability to determine when to apply cutting fluid and coolant

Sub-task

4.05 Troubleshoots equipment.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	no	yes	yes	yes	yes	yes	NV	NV	NV

4.05.01	knowledge of machine operations and components
4.05.02	knowledge of previous problems and potential machine malfunctions
4.05.03	ability to visually inspect equipment
4.05.04	ability to identify and isolate problem
4.05.05	ability to take corrective action

Sub-task

4.06 Maintains machine alignment.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

4.06.01	knowledge of types of alignment equipment such as dial indicator, precision level and square
4.06.02	ability to make adjustments
4.06.03	ability to determine where and when alignment is required

BLOCK B

BENCH WORK

Trends: *Some processes, which had traditionally been done by hand, such as deburring, are increasingly being done during CNC operations. However, when performing conventional machining, benchwork is still critical.*

Related Components: Not applicable.

Tools and Equipment: See Appendix A.

Task 5 Performs hand processes.

Sub-task

5.01 Files workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

5.01.01	knowledge of types of cuts such as coarse, bastard and smooth
5.01.02	knowledge of types of files such as single cut, double cut and needle files
5.01.03	knowledge of shapes and size of files such as round, flat and square
5.01.04	ability to select file types and file material for job requirement
5.01.05	ability to select filing technique for job requirement
5.01.06	ability to install handle onto file

Sub-task

5.02 Saws workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

5.02.01	knowledge of tooth pitch of saw blades
5.02.02	knowledge of saw blade tooth set such as raker, wave and straight
5.02.03	knowledge of sawing techniques
5.02.04	knowledge of holding techniques
5.02.05	ability to select saw blade
5.02.06	ability to install and tension blade

Sub-task

5.03 Performs hole making operations.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

5.03.01	knowledge of holding techniques
5.03.02	knowledge of types of tooling such as drills, reamers and hones
5.03.03	ability to select drill size such as fractional, metric, letter and number

Sub-task

5.04 Performs threading operations.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

5.04.01	knowledge of holding techniques
5.04.02	knowledge of taps such as taper, plug, bottom and pipe
5.04.03	knowledge of thread, pitch and form
5.04.04	knowledge of thread cutting techniques
5.04.05	ability to calculate and select tap drill size
5.04.06	ability to cut threads
5.04.07	ability to adjust die
5.04.08	ability to repair threads using tools such as nut dies and thread files
5.04.09	ability to apply cutting fluids for cooling and chip removal

Sub-task

5.05 Installs thread inserts.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

5.05.01	knowledge of types of inserts such as single coil, double coil, key insert and tabbed insert
5.05.02	knowledge of special taps
5.05.03	ability to select hole size for inserts
5.05.04	ability to use installation tools

Sub-task

5.06 Broaches workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

5.06.01	knowledge of keyseat and other broach forms
5.06.02	knowledge of types and sizes of keys
5.06.03	ability to select broaches, bushings and shims
5.06.04	ability to produce a keyway and other broach forms
5.06.05	ability to perform calculations such as depth of keyway

Sub-task

5.07 Performs pressing operations.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

5.07.01	knowledge of types of presses such as arbour and hydraulic
5.07.02	knowledge of supporting techniques
5.07.03	ability to regulate pressure
5.07.04	ability to align parts

Sub-task

5.08 Bends workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	no	no	yes	yes	no	yes	NV	NV	NV

5.08.01	knowledge of holding techniques

5.08.02	ability to determine bending temperature
5.08.03	ability to shape workpiece

Sub-task

5.09 Finishes workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

5.09.01	knowledge of lapping and honing techniques
5.09.02	knowledge of polishing and blending techniques
5.09.03	knowledge of abrasives
5.09.04	ability to select lapping and honing abrasives
5.09.05	ability to maintain lapping tables and plates

Task 6 Refurbishes components.

Sub-task

6.01 Analyzes components.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

6.01.01	knowledge of fits, clearances and tolerances
6.01.02	ability to troubleshoot and document defect
6.01.03	ability to perform visual inspection
6.01.04	ability to perform basic NDT such as dye penetrant

Sub-task

6.02 Plans procedures.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

6.02.01	knowledge of original specifications and application of components
6.02.02	knowledge of repair techniques
6.02.03	ability to plan and implement repair sequence

Sub-task

6.03 Disassembles components.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

6.03.01	knowledge of retention techniques such as snap rings, blocking collars and interference fits
6.03.02	ability to remove mechanical components such as bearings, seals and adapters
6.03.03	ability to determine damage requiring repair

Sub-task

6.04 Assembles components.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

6.04.01	knowledge of bearings
6.04.02	knowledge of types of oil seals
6.04.03	knowledge of adhesives and joining techniques

6.04.04	ability to install mechanical components
6.04.05	ability to test fit and function

BLOCK C

DRILL PRESSES

Trends: *Some specialized processes such as water jet, laser cutting and wire Electrical Discharge Machining (EDM) are increasingly replacing hole making processes in some trades and applications.*

Related Components: Not applicable.

Tools and Equipment: See Appendix A.

Task 7 Sets up drill presses.

Sub-task

7.01 Selects drill press types.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

7.01.01 knowledge of drill press types such as radial arm drill, sensitive drill press and pedestal drill

7.01.02 knowledge of capacity of drill press

7.01.03 knowledge of work holding devices and their applications

Sub-task

7.02 Plans drill press sequence.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

7.02.01 knowledge of size and types of cutting tools

7.02.02 knowledge of drill press operations such as centre drilling, drilling, counterboring, countersinking, spot facing, tapping and reaming

7.02.03	knowledge of order of drill press operations
7.02.04	knowledge of capacity of drill press
7.02.05	ability to prioritize sequence of drill press operations

Sub-task

7.03 Selects jigs, fixtures and work holding devices.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

7.03.01	knowledge of types of work holding devices such as vises, V-blocks and angle plates
7.03.02	knowledge of types of jigs and fixtures
7.03.03	knowledge of clamping pressure
7.03.04	knowledge of capacity of work holding device
7.03.05	ability to match jig, fixture and work holding devices for the job setup

Sub-task

7.04 Sets up jigs, fixtures and work holding devices.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

7.04.01	knowledge of types of work holding devices such as vises, V-blocks, angle plates and clamps
7.04.02	knowledge of types of jigs and fixtures
7.04.03	ability to position, align and secure jigs and fixtures in work holding devices

Sub-task

7.05 Selects tooling.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

7.05.01	knowledge of types of tooling such as drills, reamers and taps
7.05.02	knowledge of cutting tool characteristics such as shape, grade, geometry and capacity
7.05.03	ability to select cutting tools and tool holders to match machining operation and material of workpiece

Sub-task

7.06 Sets up tooling.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

7.06.01	knowledge of types of tooling such as drills, reamers and taps
7.06.02	knowledge of cutting tool characteristics such as shape, grade, geometry and capacity
7.06.03	knowledge of installation and positioning techniques
7.06.04	ability to mount tooling in holders and in spindles

Sub-task

7.07 Sets up workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

7.07.01	knowledge of workpiece characteristics such as shape, material and size

7.07.02	knowledge of clamping pressure
7.07.03	ability to position and secure workpiece in work holding device

Sub-task

7.08 Selects speeds and feeds. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

7.08.01	knowledge of cutting tool capacities such as depth of cut and chip load
7.08.02	knowledge of cutting tool materials such as carbide, high speed steel (HSS) and ceramic
7.08.03	knowledge of size and types of cutting tools such as drills and reamers
7.08.04	ability to determine rigidity of machine tool, workpiece and setup
7.08.05	ability to calculate speeds and feeds

Task 8 Operates drill presses.

Sub-task

8.01 Drills holes. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

8.01.01	knowledge of drilling techniques such as pecking, trepanning and deep-hole drilling
8.01.02	knowledge of tool geometry and material
8.01.03	ability to recognize tool wear

Sub-task

8.02 Cuts countersinks, counterbores, chamfers and spot faces.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

8.02.01 knowledge of reference material to determine fastener size and types

8.02.02 knowledge of reference material to determine counterbore diameter and corresponding pilot diameter

8.02.03 knowledge of required surface finish

8.02.04 ability to select countersinks and spot faces

8.02.05 ability to apply cutting fluids for lubrication and chip removal

Sub-task

8.03 Performs tapping.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

8.03.01 knowledge of tap types such as spiral flute, straight flute, spiral point and skip tooth

8.03.02 knowledge of thread types such as UNF, UNC, Acme, NPT, NPS and metric

8.03.03 knowledge of required surface finish

8.03.04 ability to apply tapping procedures such as use of tapping attachments and manual centering

8.03.05 ability to apply cutting fluids for lubrication and chip removal

8.03.06 ability to make adjustments to tapping attachments

Sub-task

8.04 Finishes holes.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

Supporting Knowledge & Abilities

8.04.01	knowledge of hole finishing techniques such as boring, honing and reaming
8.04.02	knowledge of required surface finish of hole
8.04.03	ability to recognize tool wear
8.04.04	ability to apply cutting fluids for lubrication and chip removal

BLOCK D

LATHES

Trends: *More hybrid lathes that incorporate CNC and conventional use.*

Related Components: Not applicable.

Tools and Equipment: See Appendix A.

Task 9 Sets up lathes.

Sub-task

9.01 Selects lathe types.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

9.01.01	knowledge of lathe types such as engine lathes, turret lathes and vertical lathes
9.01.02	knowledge of capacity of lathe such as swing and size
9.01.03	knowledge of work holding devices

Sub-task

9.02 Plans lathe sequence.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

9.02.01	knowledge of lathe operations such as turning, threading, boring and grinding
9.02.02	knowledge of machining capacity of lathe
9.02.03	knowledge of sequence of lathe operations
9.02.04	ability to prioritize sequence of lathe operations

Sub-task

9.03 Selects work holding devices. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

9.03.01	knowledge of types of work holding devices such as four-jaw chuck, three-jaw chuck, face plate and fixtures
9.03.02	knowledge of clamping pressure
9.03.03	knowledge of capacity of work holding device
9.03.04	ability to select work holding device to match workpiece requirements

Sub-task

9.04 Sets up work holding devices. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

9.04.01	knowledge of types of work holding devices such as four-jaw chuck, three-jaw chuck, face plate and fixtures
9.04.02	knowledge of mounting types such as cam lock and threaded spindle nose
9.04.03	ability to position, align and secure work holding device

Sub-task

9.05 Selects tooling. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

9.05.01	knowledge of types of tooling such as indexable insert and HSS

9.05.02	knowledge of cutting tool characteristics such as shape, grade, geometry and capacity
9.05.03	ability to select cutting tools and tool holders to match machining operation and material of workpiece

Sub-task

9.06 Sets up tooling.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

9.06.01	knowledge of types of tooling such as turning, boring, drilling and grinding
9.06.02	knowledge of cutting tool characteristics such as shape and dimensions
9.06.03	knowledge of installation and positioning techniques
9.06.04	ability to mount tooling in holders and in lathes

Sub-task

9.07 Selects lathe accessories.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

9.07.01	knowledge of types of accessories such as taper attachments, steady rests and follower rests
9.07.02	knowledge of contact material for steady rests and follower rests such as bronze pads, brass pads and rollers
9.07.03	ability to select accessory to match workpiece requirements

Sub-task

9.08 Sets up lathe accessories.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

9.08.01	knowledge of types of accessories such as taper attachments, steady rests and follower rests
9.08.02	knowledge of setup and alignment techniques
9.08.03	ability to position, fasten and adjust accessories
9.08.04	ability to perform calculations such as taper and parallelism correction

Sub-task

9.09 Sets up workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

9.09.01	knowledge of workpiece characteristics such as shape, material and size
9.09.02	knowledge of setup and alignment techniques such as dialling-in and shimming
9.09.03	ability to position and secure workpiece in work holding device

Sub-task

9.10 Selects speeds and feeds.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

9.10.01	knowledge of cutting tool capacities such as depth of cut and chip load

9.10.02	knowledge of cutting tool materials such as carbide, HSS and ceramic
9.10.03	knowledge of size and types of cutting tools such as boring bars, facing tools and turning tools
9.10.04	ability to determine rigidity of machine tool, workpiece and setup
9.10.05	ability to calculate speeds and feeds

Task 10 Operates lathes.

Sub-task

10.01 Turns surfaces.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

10.01.01	knowledge of required surface finish
10.01.02	knowledge of tool geometry
10.01.03	ability to prepare workpiece for machining operations using procedures such as centre drilling, machining steady rest band and facing
10.01.04	ability to turn internal and external surfaces
10.01.05	ability to recognize tool wear

Sub-task

10.02 Faces surfaces.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

10.02.01	knowledge of required surface finish
10.02.02	knowledge of tool geometry

10.02.03	ability to prepare workpiece for machining operations using procedures such as centre drilling, machining steady rest band and facing
10.02.04	ability to face internal and external surfaces
10.02.05	ability to recognize tool wear

Sub-task

10.03 Turns tapers.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

10.03.01	knowledge of required surface finish
10.03.02	knowledge of types of tapers such as Morse, Brown & Sharpe and non-standardized
10.03.03	knowledge of tool geometry
10.03.04	knowledge of procedures for turning tapers such as using taper turning attachments, using compound rests and tail stock offsets
10.03.05	ability to calculate tapers
10.03.06	ability to turn internal and external tapers such as machine tapers and self-holding tapers
10.03.07	ability to recognize tool wear

Sub-task

10.04 Knurls.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

10.04.01	knowledge of required surface finish
10.04.02	knowledge of tools and tool holders

10.04.03	ability to select knurling wheels for pattern and size
10.04.04	ability to recognize tool wear affecting knurling efficiency
10.04.05	ability to verify that knurled surface meets specifications

Sub-task

10.05 Parts off workpiece. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

10.05.01	knowledge of required surface finish
10.05.02	knowledge of types of parting tools such as carbide and HSS
10.05.03	knowledge of tool geometry
10.05.04	ability to recognize tool wear

Sub-task

10.06 Drills. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

10.06.01	knowledge of required surface finish
10.06.02	knowledge of drilling techniques such as pecking, trepanning and deep-hole drilling
10.06.03	knowledge of tool geometry
10.06.04	ability to recognize tool wear
10.06.05	ability to set up and secure workpiece
10.06.06	ability to apply cutting fluids for cooling and chip removal

Sub-task

10.07 Finishes holes.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

10.07.01	knowledge of required surface finish
10.07.02	knowledge of hole finishing techniques such as drilling, reaming, boring and honing
10.07.03	ability to recognize tool wear
10.07.04	ability to apply cutting fluids for cooling and chip removal

Sub-task

10.08 Cuts grooves.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

10.08.01	knowledge of required surface finish
10.08.02	knowledge of types of grooving tools such as carbide and HSS
10.08.03	knowledge of tool geometry
10.08.04	ability to recognize tool wear
10.08.05	ability to set up and position workpiece for grooving internal and external surfaces

Sub-task

10.09 Cuts threads.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

10.09.01	knowledge of types of common threads such as UNC, NPT, Acme and metric

10.09.02	knowledge of procedures and techniques to produce internal and external threads
10.09.03	knowledge of single and multi-start threads
10.09.04	ability to perform thread calculations
10.09.05	ability to identify left and right hand thread
10.09.06	ability to use die heads and tapping heads
10.09.07	ability to grind cutting tool to produce thread form
10.09.08	ability to set up machine to cut external and internal threads
10.09.09	ability to set up machine to cut special threads
10.09.10	ability to recognize tool wear

Sub-task

10.10 Turns eccentrics.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

10.10.01	knowledge of procedures for turning eccentric diameter
10.10.02	ability to calculate centre offset
10.10.03	ability to recognize tool wear
10.10.04	ability to set up and position workpiece for turning eccentrics

BLOCK E

MILLS

Trends: *More hybrid milling machines that incorporate CNC and conventional use.*

Related Components: Not applicable.

Tools and Equipment: See Appendix A.

Task 11 Sets up milling machines.

Sub-task

11.01 Selects mill types.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

11.01.01	knowledge of milling machine types such as vertical, horizontal, ram and turret, and horizontal boring mill
11.01.02	knowledge of capacity of milling machine
11.01.03	knowledge of work holding devices

Sub-task

11.02 Plans milling sequence.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

11.02.01	knowledge of milling techniques such as climb milling, conventional milling and boring
11.02.02	knowledge of milling machine operations such as facing, contouring, cutting T-slots and dovetails, and boring
11.02.03	knowledge of roughing and finishing operations

11.02.04	knowledge of machining capacity of milling machine
11.02.05	knowledge of sequence of milling operations
11.02.06	ability to prioritize sequence of milling operations
11.02.07	ability to operate horizontal boring mills

Sub-task

11.03 Selects work holding devices. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

11.03.01	knowledge of clamping pressure
11.03.02	knowledge of capacity of work holding device
11.03.03	ability to select work holding device to match workpiece requirements

Sub-task

11.04 Sets up work holding devices. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

11.04.01	knowledge of types of work holding devices such as vises, angle plates and V-blocks
11.04.02	knowledge of mounting and aligning techniques and procedures
11.04.03	ability to position, align and secure work holding device to match workpiece requirements

Sub-task

11.05 Selects tooling.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

11.05.01	knowledge of types of tooling such as HSS tooling, carbide tooling and carbide inserts
11.05.02	knowledge of cutting tool characteristics such as shape, grade, geometry and capacity
11.05.03	ability to select cutting tools and tool holders to match machining operation and material of workpiece

Sub-task

11.06 Sets up tooling.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

11.06.01	knowledge of types of tooling such as HSS tooling, carbide tooling and carbide inserts
11.06.02	knowledge of installation and positioning techniques
11.06.03	ability to mount tooling in tool holders
11.06.04	ability to recognize insert wear
11.06.05	ability to replace inserts
11.06.06	ability to mount tool holder in machines

Sub-task

11.07 Selects milling accessories.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

Supporting Knowledge & Abilities

11.07.01	knowledge of types of accessories such as rotary tables and indexing heads
11.07.02	ability to select accessory to match workpiece requirements

Sub-task

11.08 Sets up milling accessories.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

Supporting Knowledge & Abilities

11.08.01	knowledge of types of accessories such as rotary tables and indexing heads
11.08.02	knowledge of setup and alignment techniques
11.08.03	ability to position, fasten and adjust accessories to match workpiece requirements
11.08.04	ability to perform calculations such as direct, simple, angular and differential indexing

Sub-task

11.09 Sets up workpiece.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

Supporting Knowledge & Abilities

11.09.01	knowledge of workpiece characteristics such as shape, material and size
11.09.02	knowledge of clamping pressure
11.09.03	knowledge of datum

11.09.04	knowledge of setup and alignment techniques such as dialling-in workpiece
11.09.05	ability to position and secure workpiece in work holding device
11.09.06	ability to establish workpiece zero reference point
11.09.07	ability to align machine to datum using edge finder and digital readout system

Sub-task

11.10 Selects speeds and feeds. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

11.10.01	knowledge of cutting tool capacities such as depth of cut and chip load
11.10.02	knowledge of cutting tool materials such as carbide, HSS and ceramic
11.10.03	knowledge of size and types of cutting tools such as boring bars, end mills and face mills
11.10.04	ability to determine rigidity of machine tool, workpiece and setup
11.10.05	ability to calculate speeds and feeds

Task 12 Operates milling machines.

Sub-task

12.01 Faces surfaces. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

12.01.01	knowledge of required surface finish

12.01.02	knowledge of methods of milling such as climb milling and conventional milling
12.01.03	knowledge of tool geometry
12.01.04	ability to machine vertical, horizontal and angled surfaces
12.01.05	ability to recognize tool wear
12.01.06	ability to calculate dimensions from reference point

Sub-task

12.02 Mills profiles and pockets.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

12.02.01	knowledge of required surface finish
12.02.02	knowledge of types and applications of specialized cutters
12.02.03	knowledge of tool geometry
12.02.04	knowledge of procedures for cutting pockets and profiles such as T-slots, dovetails and keyways
12.02.05	ability to recognize tool wear
12.02.06	ability to perform profile calculations
12.02.07	ability to apply cutting fluids for cooling and chip removal
12.02.08	ability to cut profiles using accessories such as rotary tables and indexing heads

Sub-task

12.03 Drills holes.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

12.03.01	knowledge of drilling techniques such as pecking, trepanning and deep-hole drilling
12.03.02	knowledge of tool geometry and composition
12.03.03	ability to recognize tool wear
12.03.04	ability to apply cutting fluids for cooling and chip removal

Sub-task

12.04 Cuts countersinks, counterbores, chamfers and spot faces.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

12.04.01	knowledge of reference material to determine fastener size and types for selected operation
12.04.02	knowledge of reference material to determine counterbore diameter and corresponding pilot diameter
12.04.03	knowledge of required surface finish
12.04.04	ability to select countersinks and spot faces
12.04.05	ability to apply cutting fluids for cooling and chip removal

Sub-task

12.05 Performs tapping.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

12.05.01	knowledge of types of threads such as UNF, UNC and metric
12.05.02	knowledge of required surface finish
12.05.03	ability to apply tapping procedures such as use of tapping head and manual centering
12.05.04	ability to apply cutting fluids for cooling and chip removal

Sub-task

12.06 Finishes holes.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

12.06.01	knowledge of hole finishing techniques such as drilling, reaming, boring and honing
12.06.02	knowledge of required surface finish of hole
12.06.03	ability to recognize tool wear
12.06.04	ability to apply fluids for cooling and chip removal

BLOCK F

SAWS

Trends: *Increased use of specialized accessories with saws.*

Related Components: Not applicable.

Tools and Equipment: See Appendix A.

Task 13 Sets up power saws.

Sub-task

13.01 Selects saw types.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

13.01.01 knowledge of saw types such as vertical, horizontal and reciprocating

13.01.02 knowledge of capacity of saw such as speed, feed and size

13.01.03 knowledge of work holding devices

13.01.04 knowledge of shape and composition of workpiece material

Sub-task

13.02 Selects saw blades.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

13.02.01 knowledge of types and capabilities of power saws

13.02.02 knowledge of types of workpiece material and shapes to be cut

13.02.03	knowledge of blade sizes, set, tooth pitch and composition
13.02.04	knowledge of blade length and width
13.02.05	knowledge of blade effect on cutting rate, tool life, finish and accuracy
13.02.06	knowledge of break-in period of new blades

Sub-task

13.03 Installs blades.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

13.03.01	knowledge of installation techniques and procedures for various saws
13.03.02	ability to handle coiled saw blades
13.03.03	ability to measure and cut blade to size
13.03.04	ability to join and grind saw blades
13.03.05	ability to position blade in machine
13.03.06	ability to set and adjust blade tension
13.03.07	ability to set and position blade guides
13.03.08	ability to break in saw blade

Sub-task

13.04 Selects speeds and feeds.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

13.04.01	knowledge of type and capacity of saw
13.04.02	knowledge of saw blade parameters such as size, tooth pitch, set and composition

13.04.03	ability to determine rigidity of machine, workpiece and setup
13.04.04	ability to calculate speeds and feeds

Sub-task

13.05 Makes saw adjustments.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

13.05.01	knowledge of types of saws
13.05.02	ability to adjust saw settings such as angles, guides, stops, speeds and feeds

Sub-task

13.06 Sets up workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

13.06.01	knowledge of workpiece characteristics such as shape, material and size
13.06.02	knowledge of clamping pressures
13.06.03	ability to position and secure workpiece in work holding device
13.06.04	ability to position work support device

Task 14 Operates power saws.

Sub-task

14.01 Saws straight and angle cuts. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

14.01.01	knowledge of types of saws such as horizontal, vertical and reciprocating
14.01.02	knowledge of sawing procedures
14.01.03	ability to cut test piece to verify workpiece
14.01.04	ability to apply cutting fluid for cooling and chip removal

Sub-task

14.02 Cuts irregular shapes. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

14.02.01	knowledge of types of saws such as horizontal, vertical and reciprocating
14.02.02	knowledge of sawing procedures
14.02.03	ability to lay out workpiece
14.02.04	ability to feed material and follow contour layout line
14.02.05	ability to apply cutting fluid for cooling and chip removal

BLOCK G

GRINDERS

Trends: *Increased use of CNC in grinders. New advances in abrasive materials in grinding wheels.*

Related Components: Not applicable.

Tools and Equipment: See Appendix A.

Task 15 Sets up grinders.

Sub-task

15.01 Selects grinder types.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

15.01.01 knowledge of types of grinding machine such as surface, cylindrical, centreless, and tool and cutter

15.01.02 knowledge of capacity of grinding machine

15.01.03 knowledge of work holding devices

15.01.04 knowledge of grinding machine accessories such as support rests and power heads

Sub-task

15.02 Plans grinding sequence.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

15.02.01 knowledge of types and grades of grinding wheels such as cubic boron nitride (CBN), aluminium oxide and silicon carbide

15.02.02	knowledge of grinding machine operations such as surface, cylindrical, tool and cutter, and centreless grinding
15.02.03	knowledge of sequence of grinding machine operations
15.02.04	knowledge of grinding capacity of grinding machines
15.02.05	ability to prioritize the sequence of grinding operations

Sub-task

15.03 Selects work holding devices. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

15.03.01	knowledge of types of work holding devices such as centres, four-jaw chuck, three-jaw chuck, face plate, fixtures, magnetic chuck and magnetic sub-plates
15.03.02	knowledge of clamping pressure
15.03.03	knowledge of capacity of work holding device
15.03.04	ability to select work holding device to match workpiece requirements

Sub-task

15.04 Sets up work holding devices. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

15.04.01	knowledge of types of work holding devices such as centres, four-jaw chuck, three-jaw chuck, face plate, fixtures, magnetic chuck and magnetic sub-plates

15.04.02	knowledge of mounting techniques
15.04.03	ability to position, align and secure work holding devices

Sub-task

15.05 Selects grinding wheel.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

15.05.01	knowledge of types, grades and sizes of grinding wheels
15.05.02	ability to interpret standard grading system
15.05.03	ability to determine abrasive type, grain size, grade, structure and bond

Sub-task

15.06 Mounts grinding wheel.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

15.06.01	knowledge of types, grades and sizes of grinding wheels
15.06.02	knowledge of techniques and procedures for storing, handling and mounting grinding wheels
15.06.03	knowledge of blotter applications
15.06.04	knowledge of balancing techniques and procedures
15.06.05	knowledge of truing and dressing techniques and procedures such as contour dressing and diamond dressing
15.06.06	ability to visually inspect and ring test grinding wheels

15.06.07	ability to install grinding wheel on a balancing mandrel
15.06.08	ability to balance grinding wheel
15.06.09	ability to install grinding wheel on grinding machine
15.06.10	ability to select truing and dressing tools
15.06.11	ability to dress and true grinding wheel

Sub-task

15.07 Selects grinding accessories. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

15.07.01	knowledge of types of accessories such as rests, tail stock, internal grinding head, wheel dressers, laminated blocks, magnetic spring clamps, chucks, drive dogs and mandrels
15.07.02	knowledge of contact material for steady rests and follower rests such as bronze pads and brass pads
15.07.03	ability to select accessory to match workpiece requirements

Sub-task

15.08 Sets up grinding accessories. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

15.08.01	knowledge of types of accessories such as rests, tail stock, internal grinding head, wheel dressers, laminated blocks, magnetic spring clamps, chucks, drive dogs and mandrels
15.08.02	knowledge of contact material for steady rests and follower rests such as bronze pads and brass pads

15.08.03	knowledge of setup and alignment techniques
15.08.04	ability to position, fasten and adjust accessories
15.08.05	ability to perform taper calculations

Sub-task

15.09 Sets up workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

15.09.01	knowledge of workpiece characteristics such as shape, material and size
15.09.02	knowledge of setup and alignment techniques such as shimming and dialling-in
15.09.03	ability to clean and maintain magnetic work holding device
15.09.04	ability to position and secure workpiece in work holding device

Sub-task

15.10 Selects speeds and feeds.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

15.10.01	knowledge of the effect of speeds, feeds and depth of cut on finish and wheel life
15.10.02	knowledge of grinding wheels
15.10.03	ability to determine rigidity of machine tool, workpiece and setup
15.10.04	ability to calculate speeds and feeds

Task 16 Operates grinders.

Sub-task

16.01 Grinds flat surfaces.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

16.01.01 knowledge of types of surface grinders such as vertical and horizontal

16.01.02 knowledge of surface grinding techniques required to produce surfaces such as parallel, flat and square

16.01.03 ability to select grinder type

16.01.04 ability to identify when wheels require dressing

16.01.05 ability to plunge grind and traverse grind

Sub-task

16.02 Grinds profiles.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

16.02.01 knowledge of types of grinding machines

16.02.02 knowledge of types of profiles such as vees and radii

16.02.03 knowledge of cylindrical and surface grinding techniques to produce profiles such as angles, radii, recesses, shoulders and special forms

Sub-task

16.03 Grinds cylindrical and tapered surfaces.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	NV	NV	NV

Supporting Knowledge & Abilities

16.03.01	knowledge of types of cylindrical grinders such as centreless, universal, external and internal
16.03.02	knowledge of setup and alignment techniques for drive plates, grinder carriers, drive dogs, trip dogs, tail stock, centres, chucks, work heads, wheel heads and the upper table
16.03.03	ability to position and secure workpiece between centres
16.03.04	ability to perform internal, external, plunge and traverse grinding

Sub-task

16.04 Grinds tools and cutters.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	no	yes	yes	yes	yes	yes	NV	NV	NV

Supporting Knowledge & Abilities

16.04.01	knowledge of types of tool and cutter grinders such as drill grinders and end mill grinders
16.04.02	knowledge of accessories
16.04.03	knowledge of cutter types such as form relief cutters, reamers and end mills
16.04.04	knowledge of relief angles and clearances
16.04.05	knowledge of setup techniques
16.04.06	ability to sharpen cutters

BLOCK H

COMPUTER NUMERICAL CONTROL (CNC) MACHINES

Trends: *Improved interactive control features and enhanced automation features such as automatic measuring, probing and robotic loaders and unloaders. Increased use of multi-axes CNC. Increased use of high speed CNC machining resulting in higher productivity.*

Related Components: Not applicable.

Tools and Equipment: See Appendix A.

Task 17 Performs basic CNC programming.

Sub-task

17.01 Reviews process documentation.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	yes	yes	yes	NV	NV	NV

17.01.01 knowledge of order of CNC machining operations

17.01.02 ability to read and interpret workpiece documentation such as drawings and setup sheets

17.01.03 ability to read and interpret reference material such as charts, tables, CAM files and *Machinery's Handbook*

Sub-task

17.02 Calculates coordinates for tool path.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	yes	yes	yes	NV	NV	NV

17.02.01 knowledge of Cartesian Coordinate System

17.02.02	knowledge of trigonometry
17.02.03	ability to perform calculations

Sub-task

17.03 Inputs program data into control memory.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	yes	yes	yes	NV	NV	NV

17.03.01	knowledge of CNC machine control
17.03.02	ability to select and load programs
17.03.03	ability to store and retrieve programs
17.03.04	ability to manually input program data

Sub-task

17.04 Interprets program codes.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	yes	yes	yes	NV	NV	NV

17.04.01	knowledge of programming codes such as G, M and S codes
17.04.02	ability to relate program code to machine movement

Sub-task

17.05 Edits program.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	yes	yes	no	NV	NV	NV

17.05.01	knowledge of programming codes such as G, M and S codes

17.05.02 ability to review program to verify accuracy

17.05.03 ability to modify and update program

Task 18 Sets up CNC machines.

Sub-task

18.01 Selects tooling and tool holders.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	yes	yes	yes	NV	NV	NV

18.01.01 knowledge of types of tooling such as indexable insert tooling and HSS tooling

18.01.02 knowledge of types of tool holders

18.01.03 knowledge of cutting tool characteristics such as shape, grade, geometry and capacity

18.01.04 knowledge of tool holder characteristics

18.01.05 knowledge of cutting tool and tool holder identification system

18.01.06 ability to verify size and shape of cutting tool and tool holder

Sub-task

18.02 Sets up tooling and tool holders.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	yes	yes	yes	NV	NV	NV

18.02.01 knowledge of types of tooling such as indexable insert tooling and HSS tooling

18.02.02 knowledge of types of tool holders

18.02.03	ability to position and secure tooling and tool holders with techniques such as shrink fit and clamping
18.02.04	ability to orient cutting tool in tool holder
18.02.05	ability to touch off tooling and establish offsets

Sub-task

18.03 Establishes work datum.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	yes	yes	yes	NV	NV	NV

18.03.01	knowledge of CNC machine control
18.03.02	knowledge of machine codes to establish work datum
18.03.03	ability to read and interpret workpiece documentation such as drawings and setup sheets
18.03.04	ability to use probes and edge finders
18.03.05	ability to manually adjust machine axes

Sub-task

18.04 Sets up workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	yes	yes	yes	NV	NV	NV

18.04.01	knowledge of workpiece characteristics such as shape, material and size
18.04.02	knowledge of setup and alignment techniques such as dialling-in and shimming
18.04.03	ability to position and secure workpiece in work holding device

Sub-task

18.05 Verifies program.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	yes	yes	yes	NV	NV	NV

Supporting Knowledge & Abilities

18.05.01	knowledge of programming codes such as G, M and S codes
18.05.02	ability to perform dry run and single block cycle to check tool path
18.05.03	ability to relate program code to machine movement

Task 19 Operates CNC machines.

Sub-task

19.01 Adjusts offsets.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	yes	yes	yes	NV	NV	NV

Supporting Knowledge & Abilities

19.01.01	knowledge of CNC machine control
19.01.02	knowledge of types of offsets and compensations such as length, diameter and tool nose radius
19.01.03	ability to adjust machine offset parameters

Sub-task

19.02 Loads/unloads workpiece.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	yes	yes	yes	NV	NV	NV

19.02.01	knowledge of clamping pressure
19.02.02	ability to use work holding devices such as hydraulic chucks and vises

Sub-task

19.03 Monitors machining processes.

Supporting Knowledge & Abilities

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	yes	yes	yes	NV	NV	NV

19.03.01	knowledge of tool life expectancy
19.03.02	knowledge of load monitoring system
19.03.03	knowledge of machine alarms and alarm codes
19.03.04	ability to recognize signs of tool wear such as poor finish, vibration and excessive noise
19.03.05	ability to correct observed problems
19.03.06	ability to use machine overrides such as rapid override and speed and feed override
19.03.07	ability to recognize chip control problems
19.03.08	ability to ensure cutting fluid delivery

Sub-task

19.04 Interrupts program cycle. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	yes	yes	yes	NV	NV	NV

19.04.01 knowledge of manual cycle stop procedures

19.04.02 ability to move machine axes to take corrective action

Sub-task

19.05 Restarts program cycle. **Supporting Knowledge & Abilities**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	no	yes	yes	yes	yes	yes	yes	NV	NV	NV

19.05.01 knowledge of CNC machine controls

19.05.02 ability to locate restart point in program

19.05.03 ability to position machine to avoid collision on restart

APPENDICES

TOOLS AND EQUIPMENT

Personal Protective Equipment and Safety Equipment

dust mask
eye wash station
face shield
fire extinguishers
fire hoses
first aid station
goggles/safety glasses
hand protection
hearing protectors
protective head gear
respirators
safety barrier tapes
safety boots

Hand Tools

acetylene torch
Allen keys
arbour press
bearing extractor
brushes
buffing wheels
chisels (flat cold, diamond, round nose, cape, side)
chuck key
deburrers
die stock
drill drift
drill gauge
file cards
file handles
files (flat file, half round file, hand file, knife file, general purpose file , pillar file, round file, square file, three square file)
grease guns
hacksaws and blades
hammers/mallets (ball peen, dead blow, sledge, cross peen, straight peen)
hand broaches
hand reamers (solid, expansion, adjustable, taper, roughing, finishing taper)
hole saws
honing stones
lapping plate
metal stamps
oil cans/guns
pliers (standard, tongue and groove, needle nose, locking)
punches and bars (pin punch, prick punch, centre punch, aligning punch, pry bar, transfer punch, brass drifts)
scrapers (flat, three cornered)
screwdrivers (straight or flat, Phillips, Robertson, Torx)
soft jaws
tap extractors
tap wrenches
torch tip lighters
utility knife
vises (bench, machinist's)
wheel dressers (hand held)
wrenches (open-end, box end, sockets, adjustable, hex socket, torque, pipe, chain, strap, spanner)

Power Tools

air grinder
bench grinder
portable drill
specialty drills
twist drill

Machine Tools

abrasive cut-off saw
band saw (horizontal and vertical)
boring machines (horizontal and vertical)
computer numerical control (CNC) machine tools (drilling machines, turning centres, lathes, milling machines, punch press, contour machines, grinding machines)
drilling machines (sensitive drill press, upright drilling machine, gang drills, multi-spindle head, radial arm drilling machine, CNC machines, turret drilling machine)
grinders (cylindrical, surface, tool and cutter, centreless, pedestal, tool post, profile)
hydraulic press
lathe (turret, centre, engine, chucker, single and multi spindle, tracer, CNC turning centre)
milling machines (vertical, horizontal, universal, milling centres)
power hacksaw
reciprocating saw

Cutting Tools

abrasive cut-off wheels
boring bars
boring heads
broaches
carbides (cemented, inserts, solid)
changeable pilots
dies
drills
grinding wheels (aluminium oxide, silicon, carbide, boron carbide, cubic boron nitride, diamond)
knurling tools (straight, diamond)
milling cutters (HSS, carbide, carbide inserts)
reamers (machine, hand, spiral flute, straight flute, expandable, rose, taper)
spot facers
taps

Layout Equipment

combination set
dividers and trammels
etchers
hermaphrodite calipers
layout fluid
layout table
punches (centre, prick, transfer)
scribers
squares (adjustable, solid, master)
surface gauge
surface plates
vernier height gauge

Measuring Tools

angle gauge blocks
angle plate
bore gauge
combination square
coordinate measuring machine (CMM)
depth gauge
dial indicators
digital readout
dividers
drill gauge
electronic measuring devices
feeler gauge
gauge blocks/precision blocks
gear measuring wire
go-no-go gauge (threads, diametrical)
height gauge
inside calipers
inspection gauges (fixed gauges, cylindrical plug gauges, plain ring gauges, taper plug gauges, taper ring gauges, thread ring gauges, snap gauges, drill size gauges, radius gauges)
measuring rods
measuring tape
mechanical comparator
micrometer (thread, inside, outside, depth)
optical comparator
outside calipers
plug/ring gauge
precision level
protractor (universal, bevel, vernier)
radius gauge
scale (steel, rule, hook rule)
sine bar (compound)
sine plate (compound)
small hole gauge
square (solid, adjustable, cylindrical)
steel rules
surface finish comparator
surface plate
three wire thread measuring pins
transfer caliper
transfer type instruments
vernier caliper (dial, digital)
vernier height gauge

Setup Accessories and Work Holding Devices

adaptors
angle plates
arbours
centre and edge finders
centres (dead, half, rotating, spring)
chain hoists
chucks (three-jaw, four-jaw, magnetic)
clamps
collets
cutting tools
dividing head
drill chuck
face plates
follower/travelling rest
grinding attachment
grinding wheel balancers
jacks
lathe centres
lathe dogs
machine vice
mandrels
overhead crane
parallels
quick change tool post
rotary table
shim stock
spacers
steady rest
taper sleeves
taper turning attachment
tapping head
tool bits
tool holders
turret tool post
v-bloc

GLOSSARY

Block A Occupational Skills	repetitive general skills for many tasks performed by a machinist that are common to several machine tool applications
Block B Bench Work	all the activities performed using hand tools at a bench such as sawing, reaming, tapping, assembly and disassembly
Block C Drill Presses	all the activities performed on a drill press
Block D Lathes	all the activities performed on a lathe
Block E Mills	all the activities performed on a mill
Block F Saws	all the activities performed on a power saw
Block G Grinders	all the activities performed on a grinder
Block H Computer Numerical Control (CNC) Machines	all the activities performed with a CNC machine
boring	a machining process that produces a round straight hole using a single point tool
chamfer	usually a 45 degree angle machined on the start of a bore or a shaft to allow for ease of assembly
computer numerical control (CNC)	the control of a machine tool using coded instructions from a programmer or an operator
counterbore	enlarging the end of a previously created hole
countersink	creating a tapered hole on the end of an existing hole to accommodate a tapered head screw
drill press	a machine used to produce holes in workpieces; reaming, tapping, spot facing and countersinking can also be performed on drill presses

grinder	a machine that removes material from workpieces using abrasive wheels
heat treatment	the heating and cooling of metals to modify their mechanical properties
knurling	using a tool to produce a pattern on the diameter of a workpiece in a lathe
lathe	a machine that holds and rotates the workpiece; a cutting tool is moved on slideways to cut cylindrical, tapered or threaded features on a workpiece
Machinery's Handbook	a reference book used by the mechanical engineering disciplines such as engineers, toolmakers and machinists
mill	a machine that holds the workpiece while a rotating cutter with single or multiple cutting edges cut surfaces and contours
saw	a machine commonly used to cut off workpieces from bar stock using a multi-tooth blade
spot facing	a machining operation that creates a flat surface at 90° to a hole
tapping	cutting threads within a hole using a cutting tool called a tap
traverse grinding	grinding using an automatic feed
trepanning	cutting a groove in the form of a circle or boring or cutting a hole by removing the center or core in one piece

LIST OF ACRONYMS

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineering
CBN	cubic boron nitride
CMM	coordinate measuring machine
CNC	computer numerical control
EDM	electrical discharge machine
G Codes	preparatory command
HSS	high speed steel
M Codes	miscellaneous function command
NDT	non-destructive testing
NPS	National Pipe Straight
NPT	National Pipe Taper
PPE	personal protective equipment
S Codes	spindle speed control
UNC	Unified National Course (a thread system for course threads)
UNF	Unified National Fine (a thread system for fine threads)
WHMIS	Workplace Hazardous Materials Information System

BLOCKS AND TASKS WEIGHTING

BLOCK A OCCUPATIONAL SKILLS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	9	12	10	13	5	18	13	20	20	10	NV	NV	NV	13%

Task 1 Uses tools and equipment.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	35	40	35	35	35	50	38	50	60	40	NV	NV	NV	42%

Task 2 Organizes work.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	25	25	15	20	35	20	32	20	10	20	NV	NV	NV	22%

Task 3 Processes material.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	18	20	15	20	10	15	15	20	10	20	NV	NV	NV	16%

Task 4 Maintains machines and tooling.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	22	15	35	25	20	15	15	10	20	20	NV	NV	NV	20%

BLOCK B BENCH WORK

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	8	11	10	16	5	10	12	5	5	10	NV	NV	NV	9%

Task 5 Performs hand processes.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	57	60	65	65	70	80	67	70	80	60	NV	NV	NV	67%

Task 6 Refurbishes components.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	43	40	35	35	30	20	33	30	20	40	NV	NV	NV	33%

BLOCK C DRILL PRESSES

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	12	14	10	10	10	8	5	6	5	7	NV	NV	NV	9%

Task 7 Sets up drill presses.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	48	70	70	60	60	60	60	50	50	50	NV	NV	NV	58%

Task 8 Operates drill presses.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	52	30	30	40	40	40	40	50	50	50	NV	NV	NV	42%

BLOCK D LATHES

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	21	23	20	20	25	22	20	22	25	20	NV	NV	NV	22%

Task 9 Sets up lathes.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	44	60	60	60	60	40	60	50	60	50	NV	NV	NV	54%

Task 10 Operates lathes.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	56	40	40	40	40	60	40	50	40	50	NV	NV	NV	46%

BLOCK E MILLS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	20	20	20	20	25	21	25	22	25	20	NV	NV	NV	22%

Task 11 Sets up milling machines.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	51	60	60	60	60	40	60	50	60	60	NV	NV	NV	56%

Task 12 Operates milling machines.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	49	40	40	40	40	60	40	50	40	40	NV	NV	NV	44%

BLOCK F SAWS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	9	7	5	10	5	4	5	5	5	5	NV	NV	NV	6%

Task 13 Sets up power saws.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	55	75	60	60	60	80	60	70	50	60	NV	NV	NV	63%

Task 14 Operates power saws.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	45	25	40	40	40	20	40	30	50	40	NV	NV	NV	37%

BLOCK G GRINDERS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	9	8	10	11	10	6	10	5	5	8	NV	NV	NV	8%

Task 15 Sets up grinders.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	48	60	60	50	60	70	60	50	35	60	NV	NV	NV	56%

Task 16 Operates grinders.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	52	40	40	50	40	30	40	40	65	40	NV	NV	NV	44%

BLOCK H COMPUTER NUMERICAL CONTROL (CNC) MACHINES

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	12	5	15	0	15	11	10	15	10	20	NV	NV	NV	11%

Task 17 Performs basic CNC programming.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	41	50	20	0	50	50	20	40	45	20	NV	NV	NV	37%

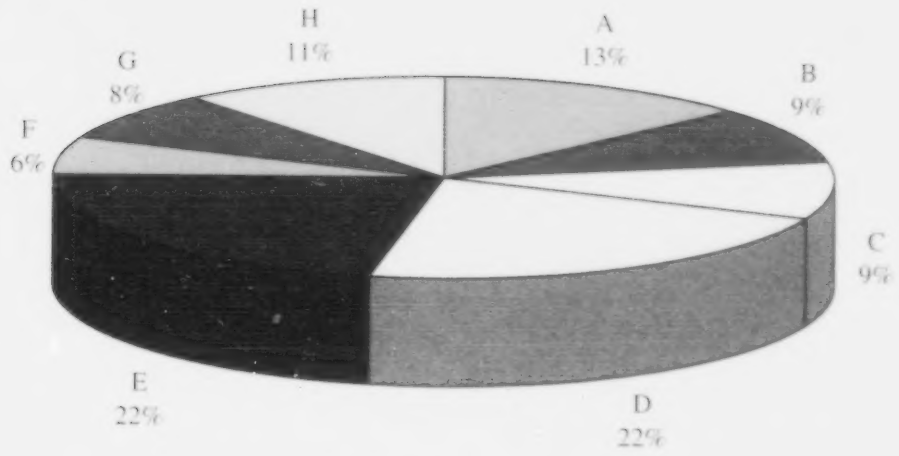
Task 18 Sets up CNC machines.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	26	40	50	0	30	30	50	40	35	40	NV	NV	NV	38%

Task 19 Operates CNC machines.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	33	10	30	0	20	20	30	20	20	40	NV	NV	NV	25%

PIE CHART*



TITLES OF BLOCKS

Block A	Occupational Skills	Block E	Mills
Block B	Bench Work	Block F	Saws
Block C	Drill Presses	Block G	Grinders
Block D	Lathes	Block H	Computer Numerical Control (CNC) Machines

* Average percentage of the total number of questions on an interprovincial examination, assigned to assess each block of the analysis, as derived from the collective input from workers within the occupation from all areas of Canada. Interprovincial examinations typically have from 100 to 150 multiple-choice questions.

TASK PROFILE CHART – MACHINIST (2005)

BLOCKS	TASKS	SUB-TASKS					
A OCCUPATIONAL SKILLS	1. Uses tools and equipment.	1.01 Uses hand tools.	1.02 Uses power tools.	1.03 Uses measuring tools.	1.04 Uses hoisting, lifting and rigging equipment.	1.05 Uses layout tools and equipment.	1.06 Uses personal protective equipment (PPE) and safety equipment.
		1.07 Uses basic welding equipment.					
	2. Organizes work.	2.01 Interprets documentation.	2.02 Plans sequence of operation.	2.03 Maintains safe work environment.	2.04 Communicates with others.		
	3. Processes material.	3.01 Selects workpiece material.	3.02 Performs layout.	3.03 Marks workpiece for identification.	3.04 Performs basic heat treatment.	3.05 Applies material testing.	3.06 Deburrs workpiece.
		3.07 Inspects workpiece.	3.08 Sketches parts.				
	4. Maintains machines and tooling.	4.01 Cleans machines.	4.02 Lubricates machines.	4.03 Sharpens tooling.	4.04 Applies cutting fluid and coolant.	4.05 Trouble-shoots equipment.	4.06 Maintains machine alignment.
B BENCH WORK	5. Performs hand processes.	5.01 Files workpiece.	5.02 Saws workpiece.	5.03 Performs hole making operations.	5.04 Performs threading operations.	5.05 Installs thread inserts.	5.06 Broaches workpiece.
		5.07 Performs pressing operations.	5.08 Bends workpiece.	5.09 Finishes workpiece.			
	6. Refurbishes components.	6.01 Analyzes components.	6.02 Plans procedures.	6.03 Disassembles components.	6.04 Assembles components.		

BLOCKS	TASKS	SUB-TASKS					
C DRILL PRESSES	7. Sets up drill presses.	7.01 Selects drill press types	7.02 Plans drill press sequence	7.03 Selects jigs, fixtures and work holding devices	7.04 Sets up jigs, fixtures and work holding devices	7.05 Selects tooling	7.06 Sets up tooling
		7.07 Sets up workpiece	7.08 Selects speeds and feeds				
	8. Operates drill presses.	8.01 Drills holes	8.02 Cuts countersinks, counterbores, chamfers and spot faces	8.03 Performs tapping	8.04 Finishes holes		
D LATHES	9. Sets up lathes.	9.01 Selects lathe types	9.02 Plans lathe sequence	9.03 Selects work holding devices	9.04 Sets up work holding devices	9.05 Selects tooling	9.06 Sets up tooling
		9.07 Selects lathe accessories	9.08 Sets up lathe accessories	9.09 Sets up workpiece	9.10 Selects speeds and feeds		
	10. Operates lathes.	10.01 Turns surfaces	10.02 Faces surfaces	10.03 Turns tapers	10.04 Knurls	10.05 Parts off workpiece	10.06 Drills
		10.07 Finishes holes	10.08 Cuts grooves	10.09 Cuts threads	10.10 Turns eccentrics		
E MILLS	11. Sets up milling machines.	11.01 Selects mill types	11.02 Plans milling sequence	11.03 Selects work holding devices	11.04 Sets up work holding devices	11.05 Selects tooling	11.06 Sets up tooling
		11.07 Selects milling accessories	11.08 Sets up milling accessories	11.09 Sets up workpiece	11.10 Selects speeds and feeds		

BLOCKS	TASKS	SUB-TASKS					
	12. Operates milling machines.	12.01 Faces surfaces	12.02 Mills profiles and pockets	12.03 Drills holes	12.04 Cuts countersinks, counterbores, chamfers and spot faces	12.05 Performs tapping	12.06 Finishes holes
F SAWS	13. Sets up power saws.	13.01 Selects saw types	13.02 Selects saw blades	13.03 Installs blades	13.04 Selects speeds and feeds	13.05 Makes saw adjustments	13.06 Sets up workpiece
	14. Operates power saws.	14.01 Saws straight and angle cuts	14.02 Cuts irregular shapes				
G GRINDERS	15. Sets up grinders.	15.01 Selects grinder types	15.02 Plans grinding sequence	15.03 Selects work holding devices	15.04 Sets up work holding devices	15.05 Selects grinding wheel	15.06 Mounts grinding wheel
		15.07 Selects grinding accessories	15.08 Sets up grinding accessories	15.09 Sets up workpiece	15.10 Selects speeds and feeds		
	16. Operates grinders.	16.01 Grinds flat surfaces	16.02 Grinds profiles	16.03 Grinds cylindrical and tapered surfaces	16.04 Grinds tools and cutters		
H COMPUTER NUMERICAL CONTROL (CNC) MACHINES	17. Performs basic CNC programming.	17.01 Reviews process documentation	17.02 Calculates coordinates for tool path	17.03 Inputs program data into control memory	17.04 Interprets program codes	17.05 Edits program	
	18. Sets up CNC machines.	18.01 Selects tooling and tool holders	18.02 Sets up tooling and tool holders	18.03 Establishes work datum	18.04 Sets up workpiece	18.05 Verifies program	
	19. Operates CNC machines.	19.01 Adjusts offsets	19.02 Loads/ unloads workpiece	19.03 Monitors machining processes	19.04 Interrupts program cycle	19.05 Restarts program cycle	